National Transportation Safety Board

Washington, D.C. 20594
Office of Marine Safety

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Person Interviewed: Bill Perkins, Detroit Diesel

Interview Conducted By: Brian Curtis
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Investigators, National Transportation Safety Board

INTRODUCTION

Detroit Diesel's marine service engineer Bill Perkins was interviewed in conjunction with the investigation concerning the *M/V Massachusetts*. The text that follows is not a verbatim record of the conversation. It has been developed from my handwritten notes of the conversation and is correct and complete to the best of my knowledge and recollection.

INTERVIEW

- Disconnected #3 fuel jumper line was injector fuel **supply** line, not return
- This disconnected line would have been detected if engine was being tested on a dyno, but given this was a 12 cylinder engine not being tested on a dyno, a person probably would not detect the one cylinder not firing properly
- Whenever a fuel jumper line is removed, or replaced with new lines, the engine would be test run with the valve cover removed
- When replacing one of these lines, you need to fire engine post-repair as they are a critical sealing point on the engine
- There is no fuel return when the injector is in the process of firing, so the pressure on the return jumper line is zero at that time
- Fuel manifolds on top of these injectors is a "pass through", so if you're producing 35 psi at the fuel pump, the fuel rail and the injector is at 35 psi

internally

- Fuel supply line pressure is dependant on the positive displacement fuel pump's output, it's a mechanical fuel pump
- At idle, Detroit's fuel pump idle spec is 5 psi
- Full load spec is 55-60 psi pump pressure
- With this jumper line disconnected, fuel would be continually spilling into the valve gear, and then drain directly back down to the oil pan
- The ensuing damage results are due to a fuel dilution of the engine's lubricating oil, it's like running the engine on water as a lubricant, as diesel fuel is slightly above the consistency of water
- Doubts the spilling fuel would pool in the valve area, due to the drain capacity in that area back to the crankcase. Drains cast in the head are more than enough to let the fuel flow back to the oil pan
- Under this spilling condition, the crankcase would fill in a few minutes
- When repairs such as this are completed, the mechanic is supposed to do a spill test. This test is conducted where fuel is recirculated off the rear of the engine's head, back to the fuel tank. If the return volume is than that being supplied, there is a leak in the system.
- There is a minimum return fuel spec for 2 cycle engines
- Not aware offhand of the flow rate on the supply side that was flowing out of the supply line, but it is a publicly supplied document for this specific engine
- Once the engine crankcase floods from this condition, we have a volatile situation.
- On a 2 cycle engine, as long as it has a combustible material in the cylinder, it will run, period, even if it's digging metal out of the bearings.
- The published spec for the temperature on the outside of the exhaust manifold is 600 degree Fahrenheit maximum
- The exhaust flanges leading from the cylinders to the exhaust manifold is the area that would reach these high temperatures. The outside engine skin temperature will be greatly reduced from that due to the water-cooling system.
- These flanges are the hottest spot you would find on the engine, straight out of the heads
- The reason for the high water temperature the operator noticed on the engine alarm console is due the introduction of a combustible material to the engine's internals in an uncontrolled manner.
- You're effectively thinning the engine oil out to a point where it's no longer lubricating, and suspect if an engine teardown were conducted, it would show extensive bearing damage.
- At this point, without lubrication, and the internal surfaces running, we're generating a lot of heat.
- When this engine flooding occurs, you get oil and diesel fuel vapors coming out of the breather on top of the valve cover, leading to a fire. Has absolutely seen this, "absolutely, multiple times".
- I've seen this condition multiple time, due to improperly installed jumper lines.
- This condition can also be caused by reusing fuel jumper lines. This is a "one-time use" item.

- Usually this leaking condition is caused by reusing a jumper line, and there was a crack in the line being reused. This allows the fuel to free-flow, and fill the engine crankcase.
- The difference in the 2 modes of failure- a cracked line versus a disconnected line- is quite different. A condition such as experienced here means a much higher volume of leaking fuel.
- The heat source for the fire could have been one of several components:
    - The marine gear cooler
    - The exhaust manifold
    - The turbocharger
- The turbocharger could have been the heat source due to the lubricating oil's having been thinned my massive amounts of a combustible material, fuel. That oil is fed directly to the turbocharger to lubricate it. The resulting heat signature off of the turbocharger could have caused an internal combustion, and actually light off inside the oil gallery, if the turbo is the source.
- The marine gear cooler is the cooler mounted on the engine, that uses raw water for a cooling medium, to cool the marine gear hydraulic fluid, similar to a radiator in a car. Its skin temperature gets very hot because the marine gear is very hot. There is a lot of friction in these units, especially in these larger craft where they have "slip clutches, and all kinds of things. A lot of friction."
- At the crankcase ventilation breather on top of the valve cover, with this fuel jumper line being disconnected, it would be exiting the breather as a vapor. Diesel fuel, in a liquid state, would never make it up to that point. There are too many orifices, passages, and vents below that level that the fuel would find, and drain back to the crankcase.
- It does sound plausible that the engine ran the timeframe, roughly a total of 20 minutes, 10 of them under heavy load, prior to the fire being noticed. "It could definitely run at least that long."
- If the process had been conducted as the mechanic explained- test run with the valve cover removed, "this fuel would have been spewing everywhere."
- An engine specification I'll throw out. The engine specification at 100% throttle, 100% load, the fuel volume, is roughly 51 gallons per hour.
- When they detected the high water temperature alarm, the fire was already present.
- I can't buy that the valve cover was off when he test ran the engine. We're talking about a volume sufficient to spray the inside of the engine compartment with this thing running. It would be like a garden hose inside the engine room.
- If he had the valve cover on, yeah, he wouldn't see it, but it's still going to be spraying.
- The reason of for the signs of heat degradation at the turbocharger's compressor side blading leading edges would be caused by the turbocharger "sucking flame" at some point from the engine room.
- "There was a fire present, and it occurred long before they got an alarm."
- As long as there is a combustible material present, it will run.
- For a Detroit Diesel field technician to work in the field, the tech would be

required to have a various training. If they were a service repair tech, they have to have the basic engine knowledge, the advanced engine overhaul course, and for the newer engines, they must have the diagnostics course.

- 2 mistakes he feels the mechanic made; he forgot to reconnect the jumper line, and he reused a fuel jumper line.
- Mr. Perkins is a Detroit Diesel 2 cycle marine service engineer

END OF INTERVIEW

Brian Curtis